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1	DFM	sig	<i>Pettit</i> 16 Aug 13 Pettit, Lt Col	6			
2	DFER	approve	<i>Kraus, Col</i> 16 Aug 13	7			
3	DFM	action	Lt Col Brian C. Payne	8			
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## SUMMARY

1. PURPOSE. To provide security and policy review on the document at Tab 1 prior to release to the public.

## 2. BACKGROUND.

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## 3. DISCUSSION.

## 4. VIEWS OF OTHERS.

5. RECOMMENDATION. Department Head or designee reviews as subject matter expert. DFER reviews for policy and security. Coordination indicates the document is suitable for public release. Suitability is based on the document being unclassified, not jeopardizing DoD interests, and accurately portraying official policy [Reference DoDD 5230.09]. Release is the decision of the originator (author). Compliance with AFI 35-102 is mandatory.

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Tab  
1. Journal Article

# **The LSI or DCA Decision: Investing Strategies for the Lump-Sum Averse**

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## **ABSTRACT**

A recent study finds that a lump-sum investing (LSI) strategy outperforms a dollar-cost averaging (DCA) strategy approximately two-thirds of the time between January 1927 and December 2011 using multiple DCA periods and adjusting for risk. This study extends these findings by examining other risk adjustment measures as well as analyzing shorter DCA periods and timing considerations. Focusing on the US stock market for the past 20 years, the LSI strategy does not dominate DCA as strongly as the prior results indicate. Instead, the decision is sensitive to the DCA duration, the timing of strategy implementation, and the risk-adjustment method considered.

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Keywords: Dollar Cost Averaging (DCA), Lump Sum Investing (LSI), Market Timing

*The views in this paper are solely the authors' and do not represent those of the Department of Defense, US Air Force, or US Air Force Academy.*

## **Introduction**

Investment advisors and professors experience a common inquiry from clients and students: “I have a large sum of money to invest. I realize the US stock market historically rises. However, I am not comfortable investing everything at once. What should I do?” A 2012 Vanguard study by Shtekhman et al of the past 80 years finds that two-thirds of the time investing the lump-sum immediately has dominated spreading the lump-sum out equally over anywhere from six to 36 months. This absolute finding also holds when adjusting for risk. Nevertheless, historical research often fails to persuade investors who are psychologically-averse to dumping their money into the market at once, knowing they could experience the immediate losses of the less-desirable scenario that occurs one-third of the time. This study extends the Shtekhman et al (2012) results to address these individuals’ concerns by analyzing the most effective dollar-cost-averaging strategies conditional upon an investor’s unwillingness to invest in a lump-sum fashion.

The key findings in this study are three-fold for the past 20 years of market performance. First, for investment contribution periods of 3 months, the DCA strategy and the LSI strategy had risk-adjusted Sharpe ratios which were statistically the same, while the DCA strategy bested the LSI strategy in absolute returns. Second, the month in which an investment strategy begins matters; LSI and DCA strategies perform differently relative to each other and relative to themselves depending on which month of the year the strategies begin. Finally, for the risk-averse investor, the DCA strategy has been less susceptible to extreme losses than the LSI strategy. That is, the Value-at-Risk (VaR) for a DCA strategy is generally smaller than for an LSI strategy.

Dollar cost averaging (DCA) is an investment strategy which promotes investing an equal monetary quantity on a regular basis. The advantage of the DCA strategy is that more shares are

acquired when prices are low and fewer shares are acquired when prices are high. The objective of DCA is to lower the total average cost per share, giving investors a lower overall cost for shares purchased over time. From a risk evaluation standpoint, a DCA strategy involves keeping a proportion of a portfolio in cash, which reduces the portfolio's return variance (i.e., risk) relative to investing the entire portfolio in the stock market using a lump-sum investing (LSI) strategy. LSI simply makes a single investment at one point in time. Generally, when most people invest, they do so by having money withdrawn from their paycheck on a regular basis, making DCA the obvious (and effectively only) choice in that situation.

However, there are situations in which the DCA approach is not necessarily the obvious choice. For example, when people experience a windfall through inheritance, receive a bonus from their employer, enjoy an unexpected tax refund, or perhaps—highly unlikely—win the lottery, the question arises as to whether they should invest the sudden fortune using an LSI or DCA approach. Perhaps more relevantly, in the wake of the 2008 financial calamity, many investors either withdrew investments or have sat out of the market because of concern over losses to retirement savings. These investors are particularly wary of an LSI strategy given how quickly they lost their savings in the 2008 timeframe. While some investors elected to discontinue regular saving to their retirement accounts, others made the choice to move funds from equity holdings to bonds or money market funds, intending to re-enter the market when they deemed the market “safe”. Thus many existing and potential investors have or will receive a lump-sum of money that they intend to invest in the market. Making a decision about when to do so is not necessarily an easy choice, logically or emotionally.

Confounding the LSI or DCA decision is the lack of consistency across the so-called experts. While the Shtekhman et al (2012) study documents the historical portfolio performance



benefits of LSI, experts in the popular press advocate gradualism for psychological reasons. A recent article states, “Even if you’re anxious to get back in the [stock market] game, you’ll want to buy into stocks gradually. Investing set amount periodically, a strategy called [DCA], helps you psych yourself into sticking to your investment plan. Putting everything in the market at once guarantees that you’ll know all too well what you’ve lost if you happen to invest at the wrong time. Investing at intervals erases that fixed reference point, which helps keep the aversion to losing money that we all have from becoming paralyzing.”<sup>1</sup>

The reported problems with DCA (see the Shtekhman et al, 2012, for example), seemingly materialize when an investor, facing the option of LSI, chooses rather to use the DCA approach. If, for example, the market is expected to trend upwards, the DCA approach can appear to have limitations because the investor is making contributions at higher prices in the future. The confusion comes about when investors perceive the apparent disadvantage of DCA to imply that market timing is superior to regularly scheduled, automatic investing via payroll deduction. If an investor perceived that the market was due for a correction, or a declining trend, they may mistakenly choose to discontinue contributing via payroll deduction, thinking it would be better to resume regular investing via payroll deduction once the market resumes trending upward. This approach is not advisable primarily because research has shown that timing the market effectively is unlikely.<sup>2</sup>

In situations where by windfall, or more likely, divestment during the financial crisis, investors often have an intuitive sense that trying to decide when to invest in the market could be potentially risky. Especially in light of market volatility over the last decade, many investors are leery of the market and are reluctant to commit funds, while lacking confidence about when to

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<sup>1</sup> “How to Learn to Love (Stocks) Again” by Anne Kates Smith, Kiplinger’s Personal Finance magazine, April 2013, pp. 29.

<sup>2</sup> See Henriksson (1984) and Keppo et al (2013) for market timing discussions.

invest. From a behavioral standpoint, prospect theory (see Kahneman and Tversky, 1979) says that investors are happy to avoid the pain of a loss of income, and somewhat less eager to enjoy the gain that comes from making money. When combined with a tendency to regret not doing something (regret avoidance) and uncertainty about outcomes (ambiguity aversion) (see Camerer and Weber, 1992, and Heath and Tversky, 1991), investors can become entrenched in a conundrum that causes an almost panicky rush to make a decision, even if the decision might not be optimal. Thus, rather than investing with an all in approach (i.e., LSI), the investor may choose to invest the money over a period of several months or even years; dollar-cost averaging (i.e., DCA).

In July of 2012, Vanguard published a study by Shtekhman et al showing that for over 80 years of stock market data from the U.S., Australia and the UK, a lump-sum investing strategy will on average, outperform a dollar cost averaging strategy approximately two-thirds of the time. This study measures DCA periods ranging from six to 36 months and shows that this outperformance occurs not only on an absolute basis but also on a risk-adjusted basis.

What the Shtekhman et al (2012) study did not analyze was the investor's decision to invest over a period of time versus lump-sum investing conditional upon a behavioral bias (e.g., the fear of a large drop in the market the next day, week, or month). The purpose of this paper is to build upon the Shtekhman et al findings and create a more complete picture by adding incrementally smaller initial DCA investment periods (3-, 4-, and 5-month), while incorporating the Value at Risk (VaR) metric, all while focusing on the most recent two decades of performance. This paper analyzes more closely the twenty years since 1992 under the contention that this period of time more likely represents today's investing environment than do the six decades prior to 1992. The key caveat to this study, as with the Shtekhman et al (2012) effort, is

that it evaluates historical market behavior. The conclusions are therefore valid to the extent that one believes the past portends the future.

The paper is organized as follows. Section 1 presents the data and provides descriptive statistics. Section 2 shows the models used for calculations, and provides an analysis of the findings. Section 3 provides a discussion and conclusion.

### **Section 1: Data and Methodology**

The data for this paper comes from Dr. Kenneth French's data library.<sup>3</sup> We use the Fama/French Factors data file, using the market return from July 1926 to December 2011. We ultimately focus on the recent 20-year period from January 1992 to December 2011. The excess return on the market value-weighted return ( $R_m - R_f$ ) of all center of research in security prices (CRSP) firms incorporated in the United States and listed on the NASDAQ, NYSE or AMEX having a share code of 10 or 11 at the beginning of month  $t$ , good shares and price data at the beginning of  $t$ , and good return data for  $t$ , minus the one-month Treasury bill rate (from Ibbotson Associates). Table 1 shows descriptive statistics for the variables used in the analysis.

Akin to the Shtekhman et al (2012) study, our purpose is to analyze the historical performance of both LSI and DCA investing strategies. LSI consists of investing an entire lump-sum into the US market and earning returns each month equal to the market return. On the other hand, a DCA strategy consists of investing  $1/n$ th the amount of the lump-sum into the market over  $n$  months (e.g., one-third of a lump-sum each month over the course of three months). The balance of the DCA position is held in cash, which we assume earns zero return and has zero risk. Since the entire lumps-sum balance is invested in the market by the beginning of the  $n$ th month, it is sufficient to measure the relative performance of the two strategies over the  $n$ -month

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<sup>3</sup> [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

holding period (LSI) and investing period (DCA). Assuming the balance remains invested in the US market into perpetuity going forward, both portfolios are completely invested by the beginning of month  $n$  and will earn identical returns beginning in month  $n+1$ . Therefore our performance comparisons end at the end of the  $n$ th month.

## Section 2: Results

Figure 1 suggests that the risk-adjusted measures using the Sharpe Ratio in the Shtekhman et al (2012) study stem from the relatively-lengthy DCA periods, which range from six months to 36 months. Shortening the DCA period to three months leads to Sharpe ratios for the DCA and LSI strategies that are statistically indifferent over the past 20 years. Consistent with the Shtekhman et al study results, the Sharpe ratios are statistically higher (at the 5 percent level) for the LSI strategy using four-month timelines and longer. Therefore, from a risk-adjusted perspective using every month across the twenty-year timeframe between 1992 and 2011, only the three-month DCA approach compares to an LSI approach in the aggregate. For this reason subsequent analysis in this paper focuses on the three-month DCA strategy.<sup>4</sup>

Recognizing the well-documented loss-aversion tendencies of many investors<sup>5</sup>, we now compare the frequency and timing with which the three-month DCA and LSI strategies experience negative returns, or absolute principal losses, across the most recent 20-year period. The opportunity to start an LSI or DCA approach beginning in every month across a 20-year time period creates a total of 240 separate measurement windows (e.g., January-March 1992, February-April 1992, March-May 1992,...,December 2011 to February 2012). Negative returns across the three-months occur in approximately the same number of three-month periods for each strategy: 82 (79) for LSI (DCA). This similarity, however, belies the tremendous

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<sup>4</sup> Four-, five-, six-, and 12-month analysis is available upon request from the authors.

<sup>5</sup> See Kahneman and Tversky (1979) and Tversky and Kahneman (1992) for a discussion of loss-aversion.



differences that occur depending on which month of the year the strategy begins. Figure 2 shows the proportion of time a portfolio experiences losses over the three-month period for the respective LSI and DCA strategies, separated by which month of the year the strategy begins. For instance, beginning the LSI (DCA) strategy in January of every year between 1992 and 2011, one would have experienced portfolio losses in 35 percent, or 7, (40 percent, or 8) of those years. While the pairwise monthly differences between the LSI and DCA strategies are not noticeably significant, except perhaps in September and November starts, there is a marked difference within strategies across the starting months. At the extreme, beginning an LSI (DCA) strategy in May (May or June) led to losses 60 percent (55 percent) of the time, whereas beginning an LSI (DCA) strategy in September (November) led to losses only 15 percent of the time. For the loss-averse investor, it appears beginning either an LSI or DCA strategy during summer months has proven particularly unsettling in the last 20 years, since losses in principal occurred at least one-half the time.

Relative performance between the LSI and DCA strategies considering timing is also worth considering, as seen in Figure 3. This figure first shows the proportion of time that the three-month DCA strategy outperforms an LSI strategy according to the starting month for each strategy. For example, when beginning a DCA strategy in January over the past 20 years, an investor would have absolutely outperformed an LSI strategy (i.e.,  $DCA3 > LSI3$ ) beginning in the same month 40 percent of the time. This January-specific result is not particularly surprising given the Shtekhman et al (2012) study's results show the DCA has historically outperformed an LSI strategy approximately 30 to 35 percent of the time in the aggregate. However, it is insightful that the frequency with which the three-month DCA approach outperforms the LSI approach approaches 50 percent in February and May, and it meets or surpasses 50 percent in

June and August. Thus there are historical circumstances where engaging in a perhaps psychologically-preferred DCA strategy is almost strictly preferred in terms of absolute returns.

The other salient point in Figure 3 stems from comparing the risk-adjusted performance of the three-month DCA and LSI strategies using the Sharpe ratio. Using this metric, past results show historically a three-month DCA approach outperforming a three-month LSI approach is lower than a 50-50 proposition across the entire annual calendar. Nevertheless, there is substantial variance in the performance of the DCA strategy relative to the LSI strategy depending upon which month of the year the strategy began. At the extremes, the DCA strategy outperforms the LSI strategy half the time on a risk-adjusted basis when starting the strategy in June, July, August, or September. On the other hand, beginning in December leads to DCA outperformance just 20 percent of the time. Overall, it appears there exists a classic risk-reward tradeoff when beginning a DCA strategy in the summer: a higher probability of outperforming an LSI strategy absolutely and on a risk-adjusted basis while concurrently experiencing a higher probability of absolute losses beginning the strategy in May or June. The data unequivocally suggests any investing starting in December should involve LSI.

Beyond the Sharpe ratio as a risk-adjustment, Value-at-Risk (VaR) provides a constructive measure for loss-averse investors who are not interested in a lump-sum investing strategy. Continuing our analysis of a three-month DCA strategy as an alternative to LSI for these individuals, Figure 4 shows VaR comparisons by month over the most recent two decades. Across the entire time period, on average, an LSI investor experienced a VaR of -11.2 percent. In other words, one out of 20 years an LSI investor could expect to lose 11.2 percent of their initial investment over the ensuing three months. Alternatively, a typical DCA investor could expect to lose 8.1 percent over the same time period. Figure 4 shows a striking difference

between LSI and a three-month DCA strategy for each month as well as the month-to-month variation within a particular strategy. The VaR for each respective strategy is greatest (least) in July (February), with the extreme month-to-month difference of almost 9 percent (slightly over 7 percent) for the LSI (DCA) strategy. The “Delta” plot shows that the VaR is greater for the LSI strategy every month, with the smallest differences in February and December. The largest differences between the strategies occur in July, September and October. In other words, investors have experienced the greatest loss potential in the summer months (June-August), and an investor who pre-commits to a DCA strategy will see the greatest potential benefit relative to an LSI strategy in terms of lower loss potential during the late-summer/early-fall timeframes of July, September, and October.

While unsuccessful in gleaning additional insights, we investigated whether previously-documented economic regime effects or investing strategies provide insight about the relative performance of a DCA or LSI strategy. Specifically, Jensen, Mercer and Johnson (1996) find market return differences depending upon whether the macroeconomic environment is contracting or expanding based on Federal Reserve monetary policy. Also, the NBER defines recessionary and expansionary business environments. Finally, Dunham and Friesen (2011) describes an enhanced DCA strategy which invests a fixed additional amount after a down month in the market, and reduces the investment by a fixed amount after an up month in the market. Unfortunately, incorporating any of these prior findings does not provide an historical advantage when making a DCA versus LSI decision.

### **Section 3: Conclusion**

The paper contributes to the area of investment strategy research by examining the relative performance of a lump-sum investing (LSI) approach versus a dollar-cost averaging (DCA) approach. It builds upon Shtekhman et al (2012) by conditioning investment strategy upon risk aversion because many investors are simply uncomfortable investing a lump-sum amount in the market at once. Because the past 20 years is presumably more indicative of the future, this paper focuses primarily on market returns documented in the 20 years since 1992. We find that when the investment contribution period was less than 6 months, the risk adjusted returns (using the Sharpe ratio) for the DCA and LSI strategy converged at the 3 month mark to be statistically identical. We also find that initiating an LSI or DCA strategy during the summer months has led to a loss of principal 50 percent of the time from 1992 to 2012, which may add credence to the old adage, “sell in May and go away”. In contrast, the three month DCA approach appears to outperform the LSI strategy by 40 or more percent in the months of January, February, April, May and July and by 50 or more percent in June and August. Thus over the past 20 years, there have been opportunities where a behaviorally-biased three month DCA strategy would have been preferable to an LSI strategy in terms of absolute returns. From a risk adjusted basis, the DCA strategy results reveal a higher probability of outperforming an LSI strategy both in absolute and risk-adjusted returns during the summer months, while at the same time exhibiting a greater chance of absolute losses if initiating the strategy in May or June. Clearly if an investor wanted to use the LSI approach, the optimal time was in December. Considering the concerns of the risk-averse investor over the last 20 years, the VaR results indicate that a DCA strategy provided the biggest advantage over the LSI strategy in terms of lower loss potential in July, September and October.



We find that over the last 20 years, while the LSI strategy was advantageous when the DCA contribution period was of a longer duration (4 – 36 months), the DCA strategy proved superior when the contribution period was 3 months, especially for certain months of the year. These results are important for several reasons: 1) the sooner an investor can be fully invested, the better the potential for long term performance, 2) a three month window is a very manageable time frame for the average investor to maintain the diligence necessary to make the regularly scheduled investments to target the DCA approach, and 3) there appears have been a trend that some months were better than others for beginning a DCA strategy.

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**Table 1****Descriptive Statistics**

Table 1 shows descriptive statistics for the variables used in the analysis. Data was obtained from Dr. Kenneth French's data library: Fama/French Factors. The monthly market return and risk free rate data covers the years 1926-2012.

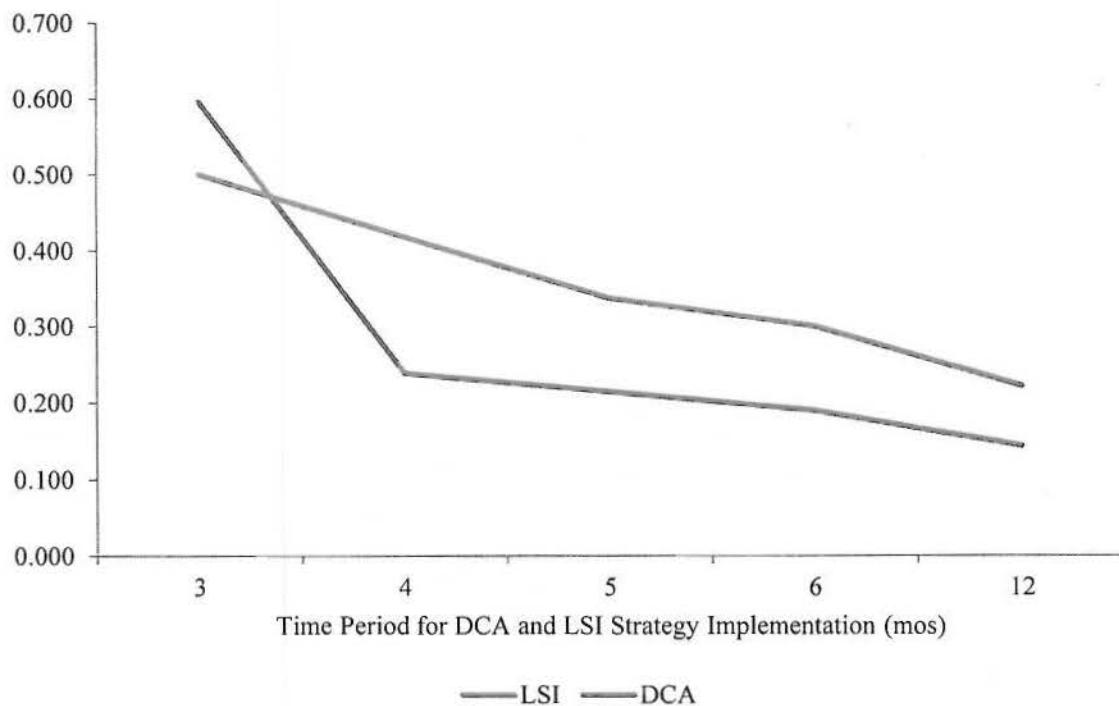
*Panel A: Summary Statistics in Levels*

Variable Name	Year Range	N	Mean	Std. Dev	Min	Max	Skewness	Kurtosis
<i>Rm-Rf</i>	1926-2012	1038	0.00626	0.05423	-0.28980	0.37770	0.16702	7.36629
<i>Rf</i>	1926-2012	1038	0.00291	0.00254	-0.00060	0.01350	1.03917	1.26212
<i>Rm</i>	1926-2012	1038	0.00917	0.05414	-0.28950	0.37870	0.13380	7.33925

**Figure 1**

**Sharpe Ratio for DCA and LSI Strategies, January 1992-December 2011**

This figure shows the Sharpe Ratios for dollar-cost averaging (DCA) and lump-sum investing (LSI) strategies over the 20-year period from January 1992 to December 2011 when investing in the broad US stock market. The two strategies are measured over 3-, 4-, 5-, 6-, and 12-month periods beginning every month over this time period and occurring on a rolling basis.

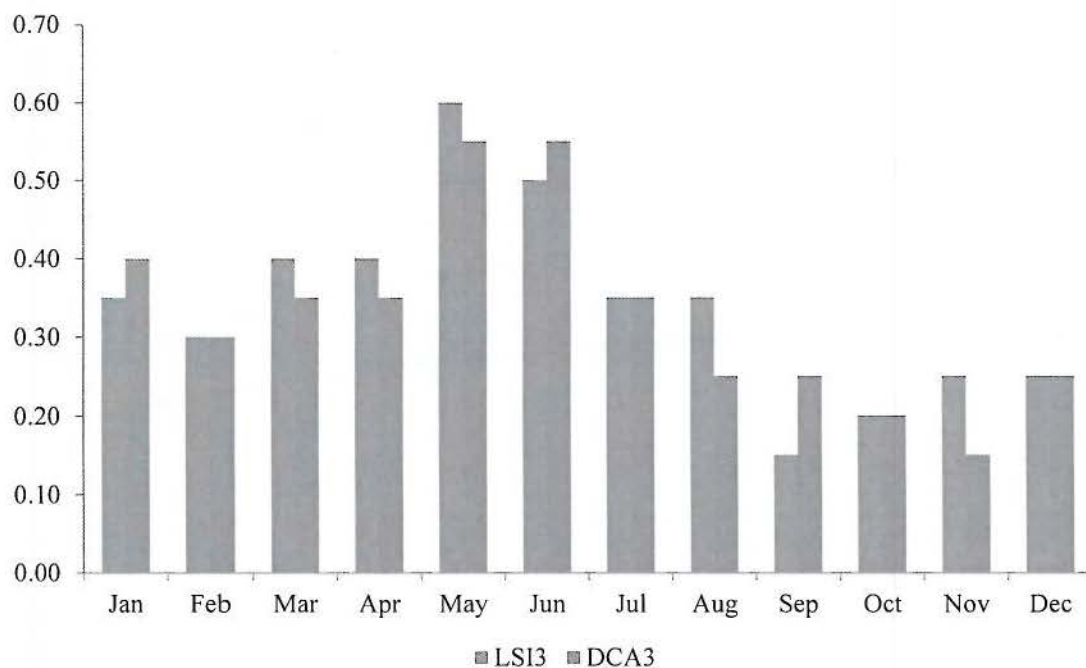




**Figure 2**

**Three-Month Absolute Losses to DCA and LSI Strategies by Starting Month, January 1992-December 2011**

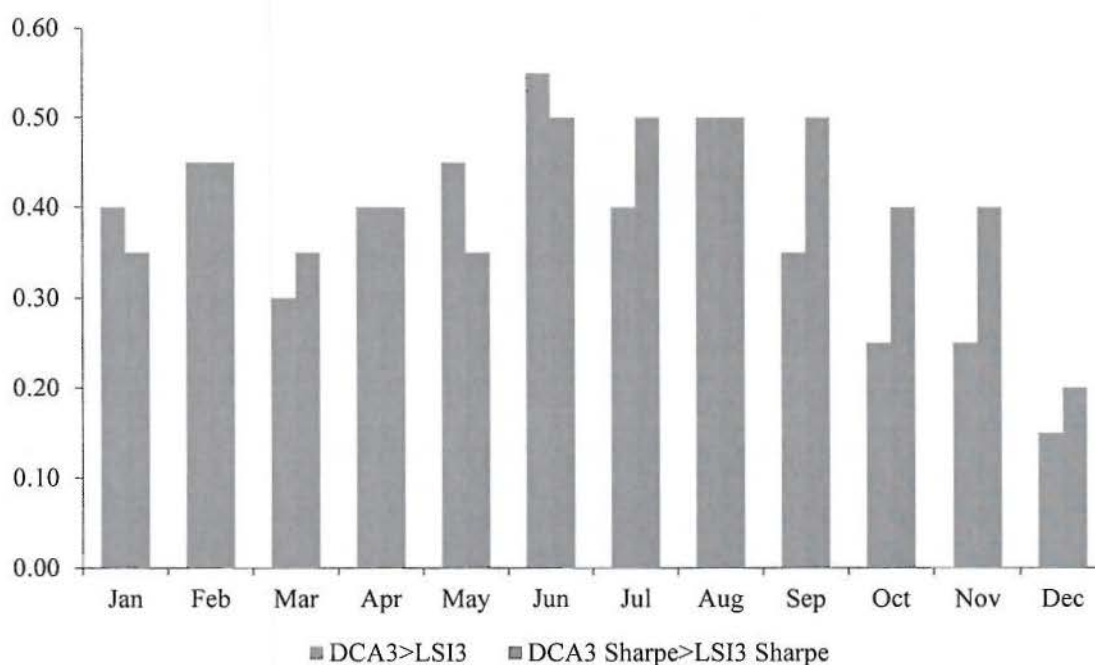
This figure shows the proportion of times a three-month dollar-cost averaging (DCA) strategy and lump-sum investing (LSI) strategy lose value over the 20-year period from January 1992 to December 2011 when investing in the broad US stock market. The two strategies are implemented beginning every month over this time period.



**Figure 3**

**Three-Month DCA Absolute and Risk-Adjusted Outperformance by Starting Month, January 1992-December 2011**

This figure shows the proportion of times a three-month dollar-cost averaging (DCA) strategy outperforms a lump-sum investing (LSI) strategy over the 20-year period from January 1992 to December 2011 when investing in the broad US stock market. The two strategies are compared beginning every month over this time period. It shows the relative performance using both absolute returns (DCA3>LSI3) and risk-adjusted returns (DCA3 Sharpe>LSI3 Sharpe) measured with the Sharpe ratio.



**Figure 4**

**Three-Month LSI 3 Month versus DCA 3 Month VaR January 1992-December 2011**

This figure shows Value at Risk (VaR) comparisons by month over the most recent two decades. VaR is calculated at the five percent level using the three-month holding period returns for a Lump Sum Investing (LSI) strategy consisting of the US market and a Dollar-Cost Averaging (DCA) strategy consisting of the US market and cash. The line plots the difference between the LSI and DCA strategies.

